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The Redevelopment and Restoration of Selected Trail BMP Features to Provide Environmental, Educational, and Aesthetic Benefits

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Introduction

Trail and Greenway systems in Montgomery and Prince George's Counties, Maryland are overseen by the Maryland National Capitol Park and Planning Commission (MNCPPC). These greenway systems are extensive and provide trails for a combined suburban and urban population of over 1.8 million people. These trails systems are also connected to the trail systems of the District of Columbia (Washington, D.C). One well known greenway system is the Anacostia Tributary Trail System which extends into all three jurisdictions. With new additions connecting existing trails in Prince George's County and the District of Columbia, the Anacostia Tributary Trail System will be one of the largest urban trail systems in the United States.

Early development and the alignment of many sections of the trails occurred in riparian areas located in protected stream valleys. MNCPPC's mission included the protection of stream valleys for water protection as early as the 1930s. The early placement of recreation based trails was not focused on more recent environmental objectives that include water pollution reduction. In addition, some stream valleys also included roadway systems that were co-aligned with trails to accommodate primarily north-south vehicular travel. Trail alignments adjacent to streams, trail material selection, site grading and construction, and relationships to co-aligned roadway systems are all criteria that sometimes differ markedly from the criteria used for more recently planned and designed trails in regards to proximity to stream and other environmental objectives.

Recently the State of Maryland passed Environmental Site Design (ESD) regulations that required the implementation of low impact development practices to provide for greater site infiltration. The general goal is to infiltrate the one inch rainfall event in order to reduce pollution, mitigate flooding and increase overall annual stream base flow.

This paper explores the feasibility of integration of water quality goals and restoration of trails in selected areas and is organized into four sections. First, I will present background information on overall water quality goals that are driving landscape renovation. In addition, the characteristics of the case study watershed are also described. Second, I present goals and objectives of this study: documentation of opportunities to use retrofitted trail water-centric BMPs to both enhance trails and meet water quality goals. Third, the results include the documentation of two existing trail opportunity types. This includes a description of the site condition, a description of the BMP solution, and the benefits and challenges of the proposed renovation BMP. Fourth, I provide a summary.

Background

This study investigates a selected segment of an existing trail located in a subwatershed of the Anacostia Tributary of the Chesapeake Bay. Sligo Creek subwatershed is one of fourteen tributary watersheds that contribute to the Anacostia River (Figure 1). The Anacostia joins with the Potomac River and opens into the Chesapeake Bay. Sligo Creek subwatershed is located in a highly developed landscape in Montgomery County, Maryland, a northern suburb of Washington, DC. The subwatershed encompasses about 11.1 square miles and is home to about 82,000 people (EPA, 2012). Within the Sligo Creek subwatershed is the Sligo Creek Trail, now a small part of the larger Anacostia Tributary Trail System. This 10.2-mile hard surface trail is one of the oldest in the county (Montgomery County Parks, 2016).

Since 1989, Montgomery County water managers have intervened in a variety of ways in the effort to improve the water quality of Sligo Creek subwatershed. From 1989 to 1999, the county constructed a series of capital improvement projects including extended-detention wet pond and marshes, detention facilities, stormwater wetlands, and stream restoration work in an effort to return Sligo Creek to more natural conditions. In 2005, in the goal of moving the Index of Biotic Integrity (IBI) from a rating of “poor” to “fair”, the county continued its efforts using LID approaches (EPA, 2012). The EPA (2012) noted that these efforts, costing 3 million USD$ since 1989, did result in a success story: improved IBI scores from “poor” to “fair” from 2000 and 2009 for fish throughout most of upper Sligo Creek.

In 2010, the United States Environmental Protection Agency (EPA) determined the Total Maximum Daily Load (TMDL), a “pollution diet”, for the Chesapeake Bay watershed for six states (New York, Pennsylvania, Delaware, Maryland, West Virginia, Virginia) and the District of Columbia. Among the many previous planning efforts, one effort included the development of Subwatershed Action Plans (SWAPs), which provided a baseline of conditions, proposed tools for achieving TMDL reductions, and visions for the selected subwatersheds. The renovation or mitigation of impermeable cover was included in the category of stormwater retrofits accounting for 34 million USD$ of the expected 45 million USD$ cost estimate to meet the new TMDL requirements (MWCOG, 2009). These expenditures provide opportunities for trail enhancements where water managers are seeking multiple benefits in order to more efficiently use public monies.

Figure 1. Sligo Creek subwatershed in the Anacostia Watershed (MWCOG, 2009)

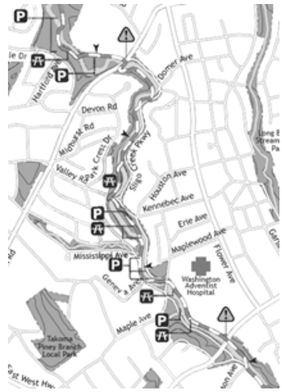

Figure 2. Sligo Creek Trail from Piney Branch Road to Carrol Road (Montgomery County Parks, 2005)

More recent interventions in Sligo Creek subwatershed, as a result of the new stormwater regulations and additional funding supported by stormwater fees, are more distributed and smaller scale. One such example of interventions is characteristic of a project in the Sligo Creek subwatershed. This project consisted of capital improvements on public right-of-ways in the Sligo Hills neighborhood community. The interventions included tree boxes, bioswales, bioretention and impervious parking pads. The goal of these interventions was to "reduce stormwater runoff, filter out pollutants, promote infiltration, and restore stream health in Sligo Creek" (Department of Environmental Protection, 2012)

Goals and Objectives

The existing background information documents substantial past efforts and expected future efforts to improve water quality. Good trail management and construction techniques are well documented in terms of reducing erosion and altering water direction, etc. More recently, trail managers are exploring the use of pervious material for infiltration. Can trails go even further and serve as stormwater BMPS to further contribute to solving water quality? And what additional benefits can be realized that make trail catchment areas, relatively small as a total of the watershed area, worth investigation. The goal of the study is twofold. The first goal is to document a trail section where trails and co-aligned roadways systems, and the impervious cover they create, can be improved by redevelopment with a focus on new ESD principles and practices. The second goal is to describe and propose potential infiltration BMPs that support water quality goals. While trails were not noted in the measures of impervious cover in the SWAP Action Plan, they do constitute a significant amount of acreage of impervious cover.

Documentation and on-site investigation of the entire trial was beyond the scope of this studio. The Sligo Creek Trail subsection investigated is a 2400 meter (7,929 feet) length of trail between Piney Branch Road and Carrol Road (Figure 2). An estimate of total impervious cover (not counting the co-aligned road way) is approximately 4800 sq. meters (52,272 square feet). Sligo Creek has an average gradient of 0.72-percent over 13.2 kilometers (8.2 miles) of its main stem length (MWCOG, 2009). Literature was collected for background information documentation. An inventory of the trail was made by walking the entire length of this selected trail segment multiple times. Various site conditions and opportunities were documented.

Results

This section outlines two opportunities beyond the more conventional technique of retrofitting existing non-permeable paved trails with pervious paving materials. In general, the focus of substitution of pavement materials is not integrated with more high capacity storage BMPs. In one application, McDonald (2011) noted that the difference in the cost for substituting pervious asphalt and regular asphalt was minimal. Pervious concrete and permeable pavers' costs are two to five times more expensive than regular asphalt or pervious asphalt (Virginia 2011).

The first opportunity type is the condition where the 2.4m (8 feet) wide trail is co-aligned with the adjacent two-lane roadway. The 2.4m (8 feet) width allows for very safe two-way traffic for multi-modal use during weekdays and Saturday. On Sunday, with the closure of the Piney Branch Parkway to cars, the trail is dominated by more walkers while the roadway accommodates all types of both pedestrians and non-motorized vehicular traffic (tricycles, bicycles, inline skaters, etc.) A heavily compacted median, containing the existing safety barrier is located between the trail and roadway (Figure 3 and Figure 4). The existing barrier is a series of upright steel H-Beams, a vertical metal fence structure with an attached horizontal wood railing (the design of the railing varies from location to location). The existing design did not include water quality goals. Water from the far reach of the road sheet flows across the road, over the safety median, across the trail, eventually sheet flowing to landscape areas between the trail and Piney Branch Creek. Numerous areas indicate excessive flows and erosion as a result of these conditions.

Possible solutions involve the construction of an integrated bioretention railing system in the renovated median. The benefits of this location include: 1) immediate capture of road sheet flow, the most significant quality of pervious area and financially supported in the SWAP plan; 2) that root damage is less likely in the median than in the placement of trenching and reservoir located between the trail and creek; and, 3) the prominent visibility for both vehicular and pedestrian users of a retrofitted bioretention safety rail BMP. The uprights could be replaced with water adapted materials (concrete, plastic, etc.). A storage reservoir to accommodate the required catchment area would be positioned both under the median and trail. Underdrains and overdrains would allow for flow over the capacity of the underground retention storage.

Figure 3. Example 1 of Co-Aligned Trail and Roadway Condition

Figure 4. Example 2 of Co-Aligned Trail and Roadway Condition

The opportunity for “Artful Rainwater Design” (Echols and Pennypacker 2015) inspired solutions are enormous. In addition to enhancements that are inspiring from a place-making perspective, environmental education both on the trail side and road side are compatible and even synergistic. The use of pervious trail replacement material and cross-sloping the sheet flow drainage back to the median would enhance the overall water quality performance of the bioretention feature. Overall, this site condition offers the greatest opportunity for significant catchment area to mitigate existing impervious area. While the overall cost would be the main challenge, both monies allocated for local roads in existing dedicated water quality funding, funds for trail retrofitting, and funds for placemaking might contribute to the feasibility of a solution.

Second opportunities for BMP intervention are site conditions where a more conventional raingarden might be proposed. Figure 5 indicates a typical condition where the proposed raingarden would be located between the trail and the stream. This raingarden would not need an overdrain, thus minimally reducing cost and landscape impact. Figure 6 indicates a typical location where the proposed raingarden location would be located upgrade and on the opposite side of the trail than that of the stream. It would likely require an overdrain to help reduce sheet flow during larger rain events from flowing back across the trail toward the stream. To reduce root damage required of a raingarden installation, soil removal by water might be considered as an alternative to mechanical removal.

Figure 5. Conventional Off-Trail Raingarden Site Condition

Figure 6. Conventional Off-Trail Raingarden Site Condition

In both cases, these raingardens offer the opportunity to introduce vegetation that might be adaptable to vernal ponds or semi-wet shaded environments. This would be an added benefit in increasing the overall biological diversity and providing additional opportunities to reintroduce native plant education. Raingardens have minimal costs. These BMP opportunities would be a much smaller catchment area than the previously noted BMP. However these features are in line with the catchment areas that have been built and are being proposed. Cumulatively, these catchment areas will make a contribution in providing for more water infiltration and thus water quality improvements.

Conclusion

Stormwater efforts are driving the retrofitting of the urban landscape including locations where trails are located. As such, additional and substantial funding to meet new water quality standards provides opportunities to retrofit existing trail environments with water-centric BMPs. Trails, while not originally the focus of watershed managers can play a small but very important role in helping water managers meet water quality goals. Moreover, the use of art-inspired design interventions and the opportunity for exposure, characterized by heavily-used public urban trail systems, offer multiple benefits for not only water quality but for placemaking and environmental education. The documentation and proposal of the two BMPs in this study offer but just two examples from this selected subwatershed and selected trail segment. Additional and broader scale investigations are likely to produce even more opportunities for the retrofitting of trails with water-centric BMPs that can meet multiple goals and provide for sustainable and healthy landscapes.

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